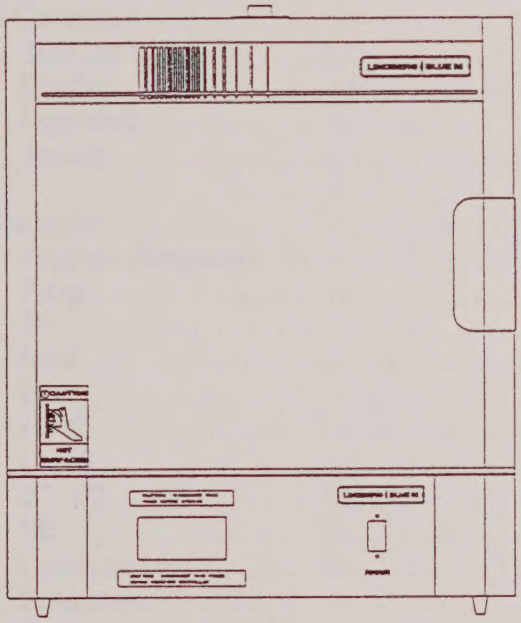
"Blue" MODEL 51848

MP MASTER
MA29152

LINDBERG/BLUE M
A GENERAL SIGNAL COMPANY

51700/51800 Series

Laboratory Box Furnace



"blue"

MODEL 51848
120V, 60 Hz
1800 WATTS

S/N 947035

MAX. TEMP. 1100°C

Covers: 51748/51848
51766/51866
51794/51894
51728/51828

LINDBERG | BLUE M

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INTRODUCTION

Thank you for choosing a Lindberg/Blue-M 51700/51800 series laboratory box furnace. This product has been designed and manufactured to the highest standards of performance. Both quality and safety have been engineered into this product to serve your laboratory heating requirements. The table below shows specifications for 51700/ 51800 Series furnaces.

Four chamber sizes are available along with two choices for temperature control. A digital single setpoint control is available in the 51700 Series, and a four segment programmable control is available in the 51800 Series. Both controllers have self tuning features to insure efficient heating. This feature and other aspects of control are discussed in further detail in upcoming sections of this manual.

Please review the information presented within this manual. Pay specific attention the cautionary and warning notes, as they are there for your safety. The heating element is made from ceramic fiber. MSDS sheets concerning contact with ceramic fiber products are located at the end of this manual. If you have any further questions about this furnace, or any other laboratory heating need, contact Lindberg at 800-657-0770.

WARNING!

TROUBLESHOOTING SHOULD ONLY BE PERFORMED BY TRAINED PERSONNEL. TROUBLESHOOTING PROCEDURES INVOLVE WORKING WITH HIGH VOLTAGES WHICH CAN CAUSE INJURY OR DEATH.

CAUTION

MAINTENANCE SHOULD ONLY BE PERFORMED BY TRAINED PERSONNEL

WARNING !!

DISCONNECT MAIN POWER BEFORE ATTEMPTING ANY MAINTENANCE TO FURNACE OR CONTROLS

Model #	Controller	Chamber	Overall	Weight	Voltage	Power
51748	AT16	4Hx4Wx8D	17.5Hx14Wx19D	43 Lbs.	120/208/240	1800
51848	847	4Hx4Wx8D	17.5Hx14Wx19D	43 Lbs	120/208/240	1800
51766	AT16	6Hx6Wx9D	21.5Hx17Wx21.5D	65 Lbs.	120/208/240	2400
51866	847	6Hx6Wx9D	21.5Hx17Wx21.5D	65 Lbs.	120/208/240	2400
51794	AT16	9Hx9Wx14D	25Hx21Wx26D	95 Lbs.	208/240	3500
51894	847	9Hx9Wx14D	25Hx21Wx26D	95 Lbs.	208/240	3500
51728	AT16	12Hx12Wx18D	28Hx24Wx30D	135 Lbs.	208/240	5600
51828	847	12Hx12Wx18D	28Hx24Wx30D	135 Lbs.	208/240	5600

INSTALLATION

Wiring

The 51748/51766 and 51848/51866 furnaces will be wired for 120 VAC service. These furnaces will also operate on 208/240 VAC. To connect the 208/240 VAC wiring to the furnace, the terminal block must be exposed. To expose the terminal block, the control plate should be removed as follows:

1. Remove the screws located on the left and right sides of the control plate (item 1).

2. Slide the plate assembly away from the unit exposing the components.

3. Locate the terminal block labeled L1, L2 in the rear corner (item 2).

When the terminal block is accessible feed-wires through the port in the rear of the furnace. Once fed through, the wires* should be connected to L1 and L2 of the terminal block. A grounding screw is provided on the brace supporting the heating unit. For conversion from 120 to 208/240 VAC, Figure II shows the proper wire configuration. For voltage conversion these changes MUST be made.

***All wiring should follow local codes.**
***Lindberg recommends the use of 12 awg SEW wire for all 51700/51800 series furnaces.**

The larger models (51794/51894, 51728/51828) will need user provided 208/240 VAC lines, and appropriate switch or circuit breaker. Incoming lines must be connected to L1 and L2 on the terminal block. A grounding screw is provided on the left support brace, near the front of the unit.

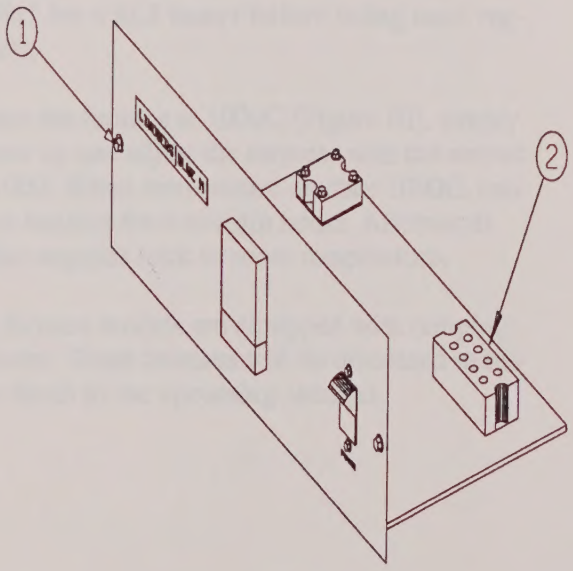


Figure I
Control Plate Removal

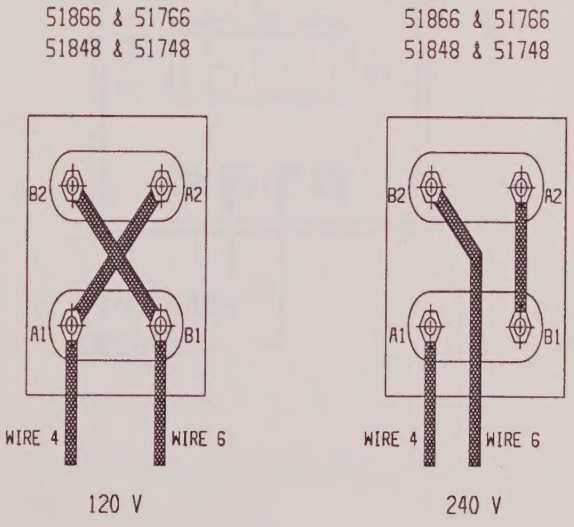


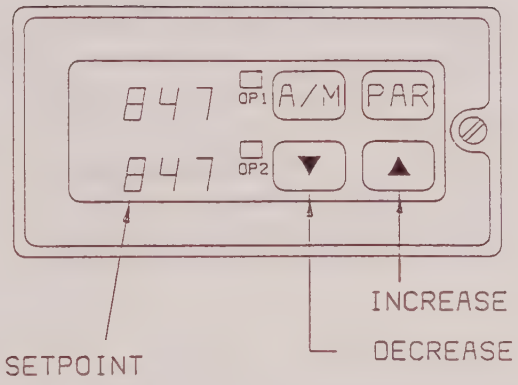
Figure II
120 to 208/240 Conversion
(Models 51748/51766, 51848/51866)

OPERATION

CAUTION

Observe the following precautions when operating the furnace.

1. Never stand in front of an open furnace.
2. Wear protective eyewear.
3. Wear protective gloves.
4. Use tongs to place and remove load from furnace.
5. Avoid contact between the walls of the furnace and the load.
6. Always use a hearth plate on the bottom of the furnace.



START UP/ ELEMENTS

When heated the elements form a thin oxide layer on their surface. This layer can prevent rapid deterioration of the element material. **For maximum life elements should be run at 1000C for 6 to 8 hours before being used regularly.**

To set the furnace at 1000C (Figure III), simply power up and adjust the setpoint with the arrows to 1000. When temperature reaches 1000C, continue heating for 6 to eight hours. Afterwards adjust setpoint back to room temperature.

All furnace models are equipped with ramping features. These features will be discussed in further detail in the upcoming sections.

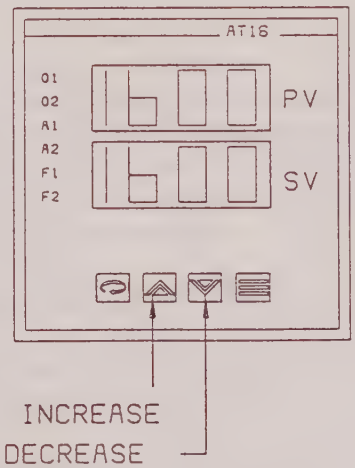


Figure III
Setpoint Operation

CONTROLLERS

Each furnace is equipped with a controller. The 51700 Series furnaces will be equipped with the AT 16, and the 51800 Series will have the 847 controller. See Figure III.

AT 16 Controller (51700 Series)

The AT 16 controller is designed to be a single setpoint controller. Digital technology and the ability to tune the controller to PID parameters insure the most efficient heating. The tune function is initiated simply with one button on the display. The AT 16 and its functions will be discussed in further detail in the following sections.

Start up

When powered up all LEDs will illuminate. After 3 to 4 seconds the display will read two numbers. The lower number being the setpoint and the upper being the actual furnace temperature (Figure III).

Display

The display will be the key to understanding the furnace functions. The following is a brief explanation of the display.

O1 Output 1, when this LED is on the heating unit is receiving power.

O2 Output 2, this output is set for the alarm.

A1 When on, alarm driver for alarm 1 is energized.

A2 When on, alarm driver for alarm 2 is energized.

F1,F2 Data transmission.

⬭ Parameter key

^ Up arrow, increases setpoint

˅ Down arrow, decreases setpoint

≡ Mode key
-press anytime to return to setpoint
-press 3 seconds to enter standby mode
-press for 6 seconds to enter autotune mode

SV Setpoint (variable)

PV Furnace temperature (process variable)

Operation

The AT 16, because it is a setpoint controller, is simple to use. The controller is set up such that after power up the user need only to adjust the arrows to the setpoint. The furnace will then begin heating to this temperature.

Tuning

In some applications where larger loads are being heated, or lower temperatures are used, there is a need for the controller to be tuned. Tuning prevents overshoots and oscillating above and below the setpoint.

If tuning is desired follow these steps:

1. Place load similar or equal to that of the process in the furnace.

2. Using the arrow keys, adjust the setpoint to that of the process.

3. Press and hold the mode key for 6 seconds.

4. Release the mode key when the lower display shows "tunE".

The controller will blink "tunE" until the tuning has finished. The tuning process will take 10 - 20 minutes.

847 Controller (51800 Series)

The 847 controller is fully programmable with 2 ramps and 2 dwells. It also has a tuning feature which will help the furnace heat as efficiently as possible. The operation and functions of this controller are discussed in more detail in the following sections.

Program Parameters

The 847 has programming capabilities which can be changed for different applications, by changing the control parameters. Figure IV has a listing the parameters contained in the 847, and their order in which they are seen in the controller. A description of the parameters will follow.

Parameter	Function
Prog	Arrows select IdLE, run, Hold.
SP	Setpoint after program is complete. Arrows adjust.
tunE	Automatically assigns tuning values.
LC	Amount of time program runs. Arrows adjust from 1 to 200.
r1	Rate of ramp 1. Degrees/minute. Arrows adjust from .01 to 99.99.
L1	Temperature level to which r1 heats.
d1	Dwell or soak time in minutes at L1.
r2	Rate of ramp 2. Degrees/minute. Arrows adjust from .01 to 99.99.
L2	Temperature level to which r2 heats.
d2	Dwell or soak time in minutes at L2.
Hb	Used when ramp rates are too large.

Figure IV

Prog

This parameter has three settings IdLE, run, and Hold. When the unit is powered up it will be in the IdLE mode. In this mode the furnace will heat to the setpoint (bottom number) on the display. Parameters for programming should be altered in this mode. Pressing the up arrow key will change the Prog parameter to the run mode. This mode starts the program running. Pressing the up arrow again will put the program in the hold mode. This mode stops the program from running. The controller will hold at the setpoint at which the program was stopped.

SP

This parameter is called the base setpoint. The controller will return to this setpoint only after the program has been completed. This setpoint is adjusted with the up and down arrows.

tunE

This parameter when set on with the adjustment arrows will automatically assign tuning values to the controller. These values will be specific to process characteristics.

LC

The loop counter can be adjusted with the arrows from 1 to 200. This number indicates the amount of times the controller will run a set program.

r1, r2

r1, and r2 are the rates in which the program will ramp to the levels specified in the program (L1,L2). The arrows will adjust this number from .01 to 99.99 degrees/minute.

L1, L2

These are the levels which r1, and r2, will ramp

to in the program.

d1,d2

The time the furnace will stay at levels **L1**, and **L2**, are adjusted with **d1**, and **d2**. These dwells can be adjusted from 0 to 9999 minutes.

Hb

The holdback function is used when the furnace cannot heat as fast as the rate (**r1, r2**) set in the controller. This is most important when soak times need to be very accurate. This number in degrees is adjusted by the arrows.

Programming

With the parameters previously covered it is possible to program the 847 controller to specific applications. The following sections will describe and show sample programs. As a reminder, to reach this list of parameters, the **PAR** key must be pressed.

Example 1

The first program involves ramp (**r1**) to a level of 1000C (Figure V), at a rate of 50C/ minute. At this level (**L1**) the furnace will dwell (**d1**) for 40 minutes. After 40 minutes the controller and furnace will continue to stay at the setpoint (**SP**), which is 1000C. The furnace will remain at this temperature until the setpoint (**SP**) is changed, or another program is initiated. The program is as follows:

SP	1000	d1	40
tunE	OFF	r2	.01
LC	1	L2	1000*
r1	50.00	d2	0
L1	1000	Hb	20

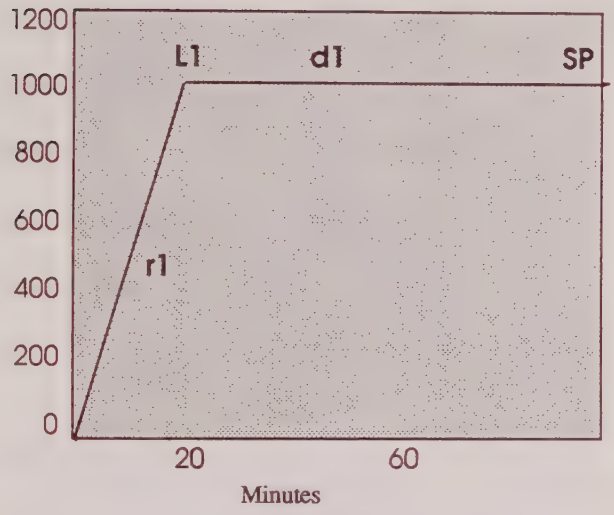


Figure V
Example 1

*Note: For single ramp programs, L2 MUST = L1.

Example 2

This program heats at a rate of 50C/ minute to a temperature level (L1) of 1000C (Figure VI). The program then holds the temperature at L1 for 40 minutes (d1). The controller and the furnace then return to the setpoint (SP) of 800C. The furnace in this case will only return to the set point of 800C as fast as the natural cooling allows. The program is as follows:

SP	800	d1	40
tunE	OFF	r2	.01
LC	1	L2	1000*
r1	50.00	d2	0
L1	1000	Hb	20

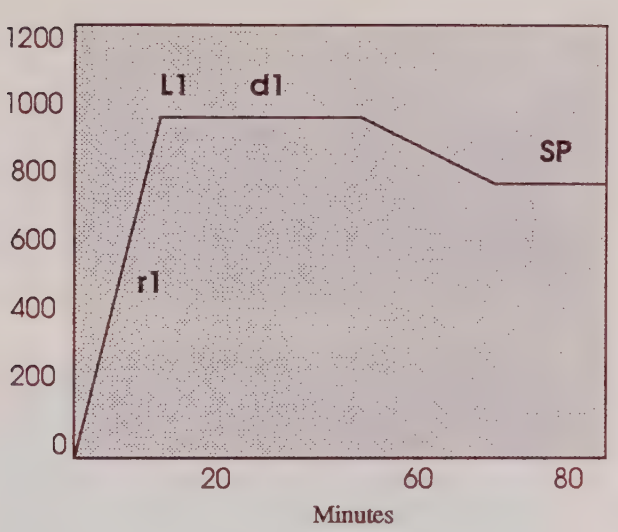


Figure VI
Example 2

*Note: For single ramp programs, L2 MUST = L1.

Example 3

This program begins heating at a rate of 60C/ minute (r1) until it reaches a level (L1) of 600C (Figure VII). The furnace will stay at that temperature for 30 minutes (d1). After 30 minutes the furnace will again ramp at a rate of 60C/ minute to the second level (L2) of 900C. The furnace will hold at this temperature for 35 minutes and then will begin to cool to the setpoint (SP) of 500C. The furnace will hold at this temperature until the setpoint (SP) is changed, or another program is initiated.The parameters are as follows:

SP	500	d1	30
tunE	OFF	r2	60.00
LC	1	L2	900
r1	60.00	d2	35
L1	600	Hb	20

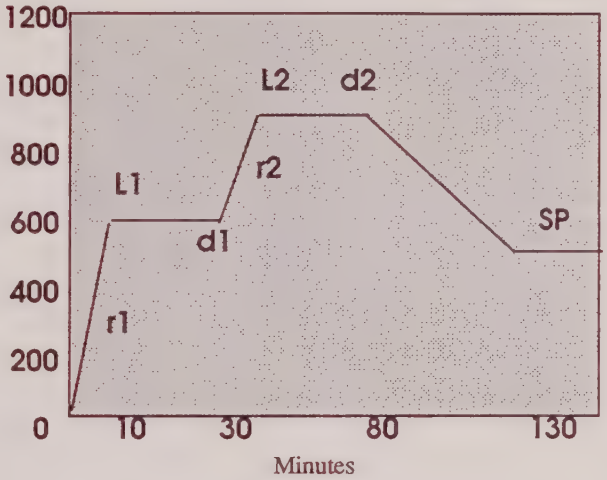


Figure VII
Example 3

MAINTENANCE

CAUTION

MAINTENANCE SHOULD ONLY BE PERFORMED BY TRAINED PERSONNEL

WARNING !!

DISCONNECT MAIN POWER BEFORE ATTEMPTING ANY MAINTENANCE TO FURNACE OR CONTROLS

Thermocouple Replacement

Thermocouple life will vary with different processes. It is recommended that thermocouples be replaced once every year. In some situations a more frequent replacement schedule may be warranted. **Snb**, or **Err H** on the controller display will indicate a broken thermocouple. The following steps will explain the replacement procedure, refer to Figure VIII.

1. Remove screws from corner of rear panel.

2. Remove rear panel, exposing rear of heating unit, and thermocouple.

3. Remove thermocouple head screws.

4. Slide out head and old thermocouple (Figure VIII).

5. Loosen lugs and remove thermocouple wires.

6. Replace thermocouple, and connect new wires. *Red lead wires will always correspond to red thermocouple wires.

7. Reassemble furnace.

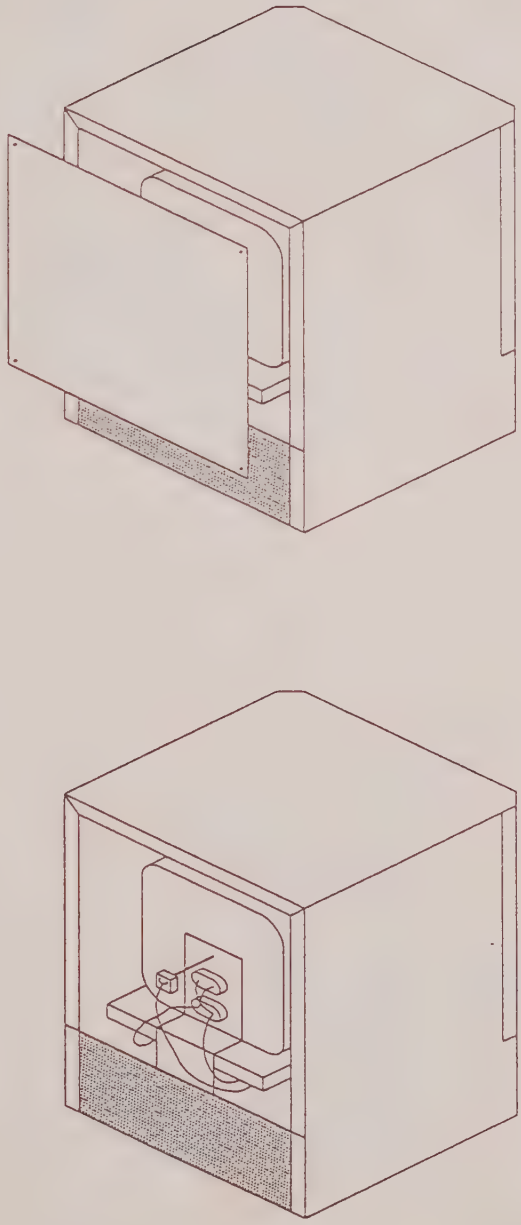
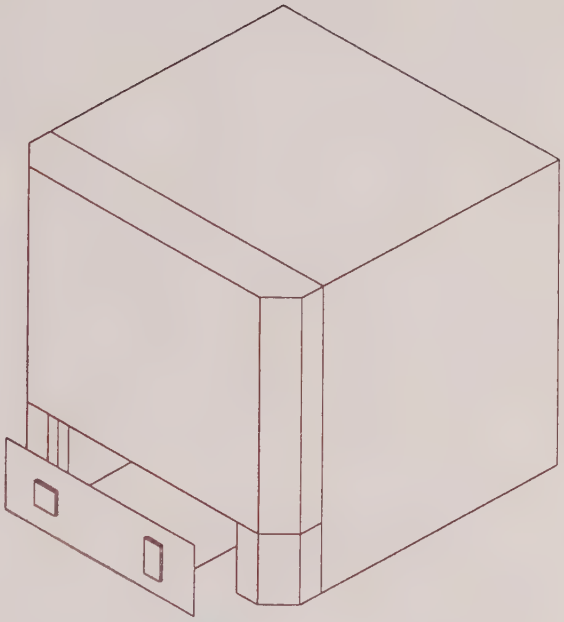


Figure VIII
Thermocouple replacement

WARNING !!
DISCONNECT MAIN POWER
BEFORE ATTEMPTING ANY MAINTENANCE
TO FURNACE OR CONTROLS



Solid State Relay Replacement

Refer to Figure IX in the trouble shooting section for relay testing. If the solid state relay is determined inoperable, the following steps can be used in replacement (Figure IX).

1. Remove screws located on the left and right sides of the control plate (Item 1).

2. Slide the plate assembly away from the unit exposing components.

3. Locate solid state relay in rear corner of component plate (item 2).

4. Remove wires from terminals of solid state relay, taking note of wire placement.

4. Remove mounting screws from solid state relay.

5. Replace solid state relay and reconnect wires.

8. Reassemble unit.

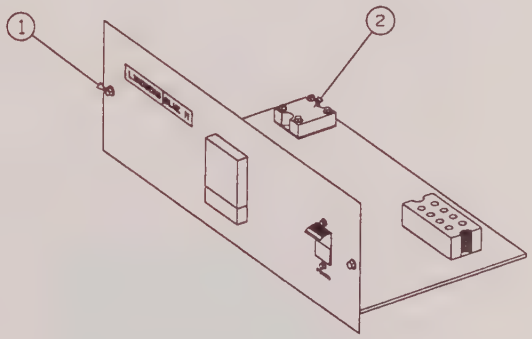


Figure IX
Solid State Relay Replacement

WARNING !!
DISCONNECT MAIN POWER
BEFORE ATTEMPTING ANY MAINTENANCE
TO FURNACE OR CONTROLS

Heating Unit Replacement

If it becomes necessary to replace the heating unit, the following procedure should be observed (Figure X).

1. Disconnect main power. Check fiber warning in Appendix.

2. Remove screws from corners of rear panel (Item 1).

3. Remove rear panel exposing heating unit assembly (Item 2).

4. Remove six corner screws from shell (Item 3).

5. Lift shell away from base of cabinet exposing entire heating unit.

6. Loosen terminal nuts and remove element wires (Item 4).

7. Remove thermocouple head screws and slide thermocouple out (Item 5).

8. Unhook spring-bands from base of chassis.

9. Replace heating unit and reassemble.

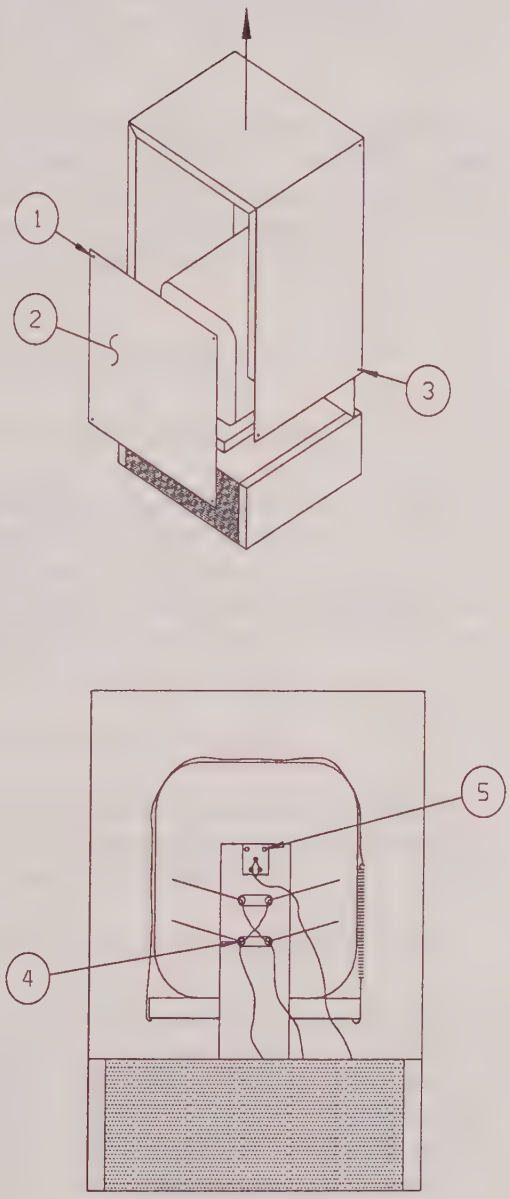


Figure X

WARNING!

TROUBLESHOOTING SHOULD ONLY BE PERFORMED BY TRAINED PERSONNEL. TROUBLESHOOTING PROCEDURES INVOLVE WORKING WITH HIGH VOLTAGES WHICH CAN CAUSE INJURY OR DEATH.

TROUBLESHOOTING

The following will be a guide to troubleshooting furnace problems. Furnaces will be identified in this section by the type of controller.

AT16 Controller (51700 Series)

Problem: Controller reads Err H.

1. Check thermocouple. If break is evident, replace. Thermocouple may need to be checked with ohmmeter for continuity. If there is no continuity, replace. Also, check all thermocouple connections. Connections should be clean and free of corrosion.

2. Check solid state relay. Remove controller by pulling grips on the edge of the face. With the power to the furnace on, the furnace should not heat. If the heating unit continues to heat, replace the solid state relay.

Problem: Furnace temperature runs away.

1. Check solid state relay. Remove controller by pulling grips on the edge of the face. With the power to the furnace on, the furnace should not heat. If the heating unit continues to heat, replace the solid state relay.

Problem: Furnace does not heat.

1. Check door interrupt switch. Put pressure on switch arm. If furnace with switch pressed starts to heat, adjust arm of switch to insure its contact with the door.

2. Check heating unit. If burned out, heating unit will be open circuit. With power diconnected, connect ohmmeter to terminal nuts at the rear of the heating unit. If small resistance is not read (5 - 30 ohms), replace heating unit.

847 Controller (51800 Series)

Problem: Controller reads Snb

1. Check thermocouple. If break is evident, replace. Thermocouple may need to be checked with ohmmeter for continuity. If there is no continuity, replace. Also, check all thermocouple connections. Connections should be clean and free of corrosion.

Problem: Controller reads ur

1. Check thermocouple. Leads are reversed. Reconnect thermocouple, red thermocouple wire corresponds to red lead wire.

Problem: Furnace temperature runs away.

1. Check solid state relay. Remove controller by loosening screw at lower right corner. Face will pull away from chassis. Pull controller out. With controller out, and the power to the furnace on, the furnace should not heat. If the heating unit continues to heat, replace the solid state relay.

Problem: Furnace does not heat.

1. Check door interrupt switch. Put pressure on switch arm. If furnace with switch pressed starts

to heat, adjust arm of switch to insure its contact with door.

2. Check heating unit. If burned out, heating unit will be open circuit. With power disconnected, connect ohmmeter to terminal nuts at the rear of the heating unit. If small resistance is not read (5 - 30 ohms), replace heating unit.

ATMOSPHERE SYSTEMS

The 51700/51800 Series furnaces are not designed for use with combustable or inert atmospheres requiring an air tight chamber. If exhaust port is used, furnace should not be used in enclosed area without proper ventilation.

WARNING !

THE USE OF COMBUSTIBLE GASES IN THIS FURNACE IS NOT RECOMMENDED

CAUTION !

AVOID PRODUCTS OF COMBUSTION WHICH WILL GENERATE TOXIC OR HAZARDOUS, VAPOR OR FUMES. WORK SHOULD ONLY BE DONE IN PROPERLY VENTED ENVIRONMENT.

APPENDIX

WARNING

THIS PRODUCT CONTAINS CERAMIC FIBER OR OTHER REFRACTORIES, WHICH CAN RESULT IN THE FOLLOWING:

May be irritating to skin, eyes, and respiratory tract.

May be harmful if inhaled.

May contain or form cristobalite (crystalline silica) with use at high temperature (above 1600F), which can cause severe respiratory disease.

Possible cancer hazard based on tests with laboratory animals. Animal studies to date are inconclusive. No human exposure studies with this product have been reported.

BEFORE MAINTAINING THIS EQUIPMENT. READ THE APPLICABLE MSDS (Material Safety Data Sheets).

WHEN INSTALLING, MAINTAINING, OR REMOVING THE REFRACTORY INSULATION, TAKE THE FOLLOWING PRECAUTIONS TO MINIMIZE EXPOSURE TO THE DUST AND/ OR CERAMIC FIBER.

Keep personnel exposure to airborne dust and particles from the insulation as low as possible.

Use a good vacuum to clean area and equipment. Do NOT use compressed air.

Use NIOSH high efficiency respirator (3M #8710 or equal.).

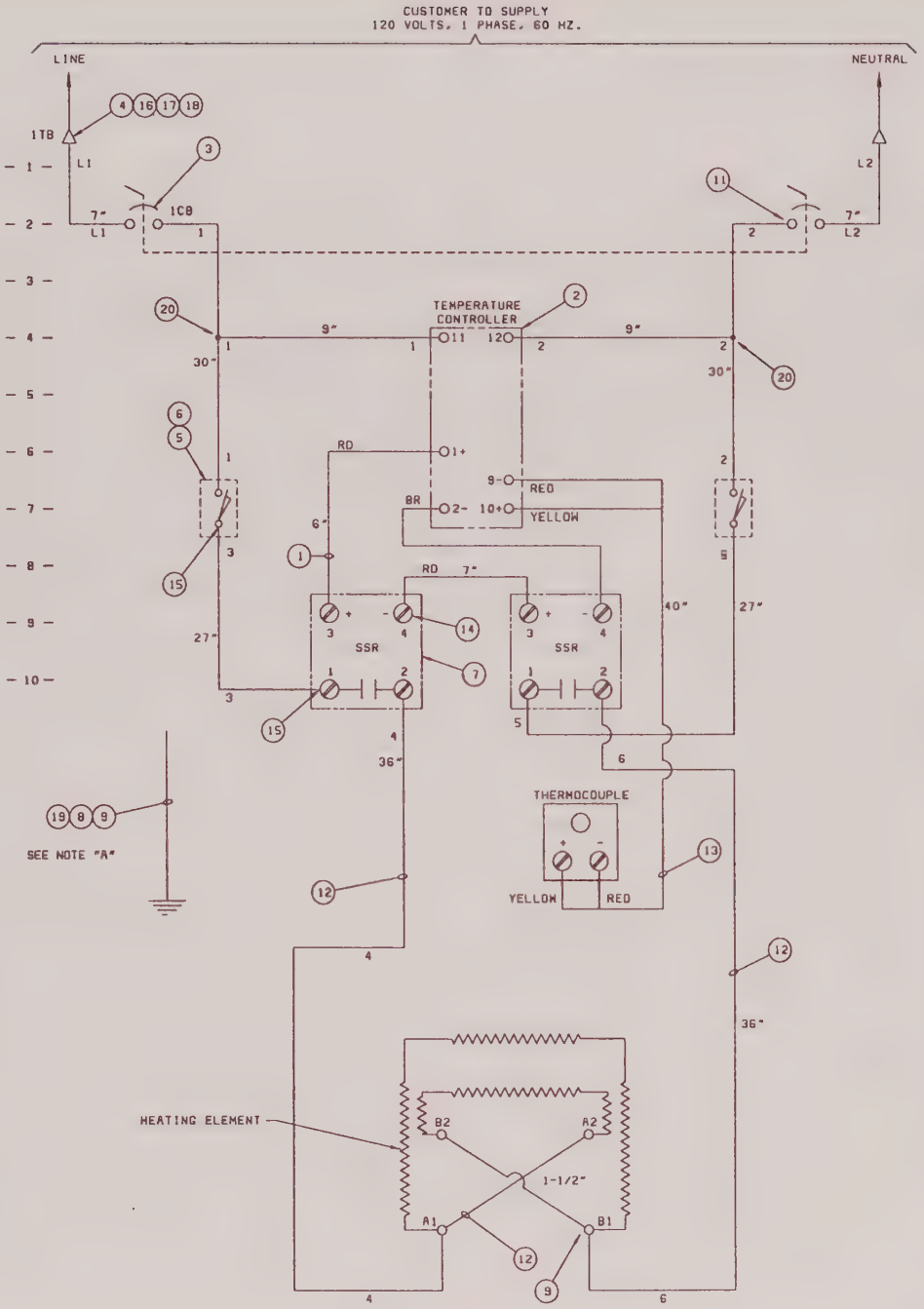
Wear long sleeve clothing, gloves, hat and eye protection, to minimize skin and eye contact. Contact lenses should not be worn when handling.

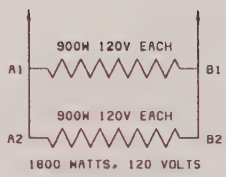
Thoroughly wash self after work is complete.

Launder work clothing separate from other clothes and thoroughly clean laundering equipment after use. If clothing contains a large amount of dust and/or ceramic fiber then dispose of rather than cleaning.

Promptly place used ceramic fiber parts and dust in plastic bags and dispose of properly.

51748



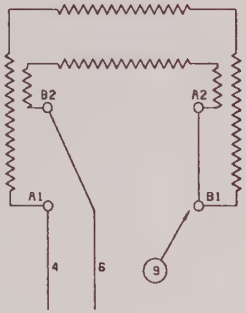


SCHEMATIC DIAGRAM OF HEATING ELEMENTS

NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

MODEL #51748 BOX FURNACE

1800 WATTS, 120 VOLTS, 15 AMPS
1800 WATTS, 240 VOLTS, 7.5 AMPS

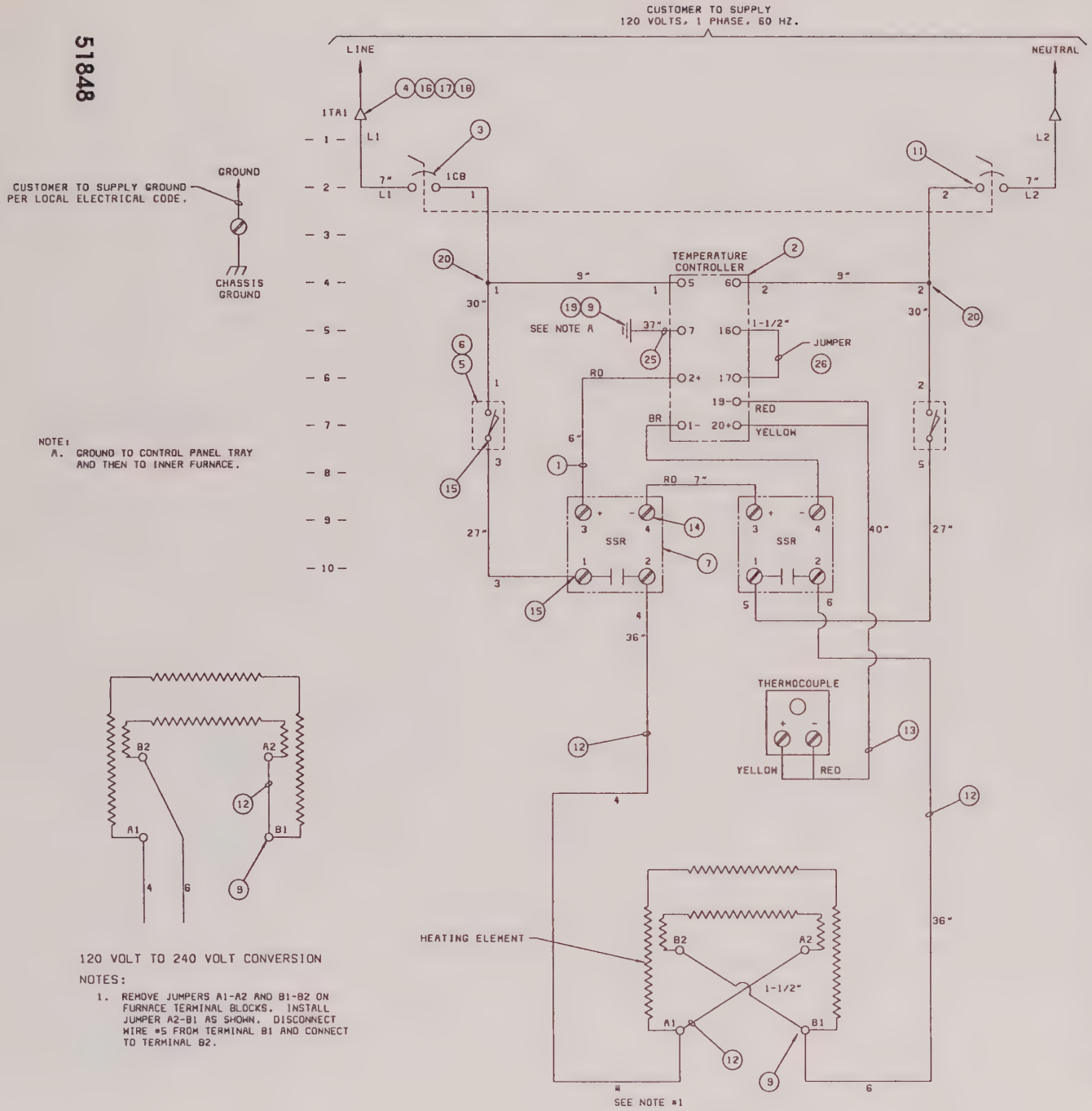


120 VOLT TO 240 VOLT CONVERSION

NOTES:
1. REMOVE JUMPERS A1-A2 AND B1-B2 ON FURNACE TERMINAL BLOCKS. INSTALL JUMPER A2-B1 AS SHOWN. DISCONNECT WIRE #6 FROM TERMINAL B1 AND CONNECT TO TERMINAL B2.

ASSY QTY	PART NO.	ITEM	DESCRIPTION
2	22053-050	20	LUG,SLIP-ON 18-14GA PIGBK NONINS
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,ROHD SL 10-32 X 1-1/4
8	22063-026	15	LUG,SPADE 16-14GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 40"
1	22012-003	12	WIRE 14GA SEW-2 BLK X 224-1/2"LG
6	22060-005	11	LUG,SLIP-ON 16-14GA FEM NONINS
1	2-7218-2052-0AS	10	CORD SET 15A 120V 6FT
7	22060-075	9	LUG,RING 16-14GA #10STUD
1	22010-033	8	WIRE 14GA TEW GREEN X 110"LG
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32600-013	3	CB 20A 2P 240V
1	4-7014-1085-001	2	CONT,TEMP #AT16
1	22006-001	1	WIRE 22GA BROWN/RED X 13" LG

51848



NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

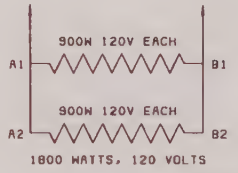
120 VOLT TO 240 VOLT CONVERSION

NOTES:

1. REMOVE JUMPERS A1-A2 AND B1-B2 ON FURNACE TERMINAL BLOCKS. INSTALL JUMPER A2-B1 AS SHOWN. DISCONNECT WIRE #5 FROM TERMINAL B1 AND CONNECT TO TERMINAL B2.

MODEL #51848 BOX FURNACE

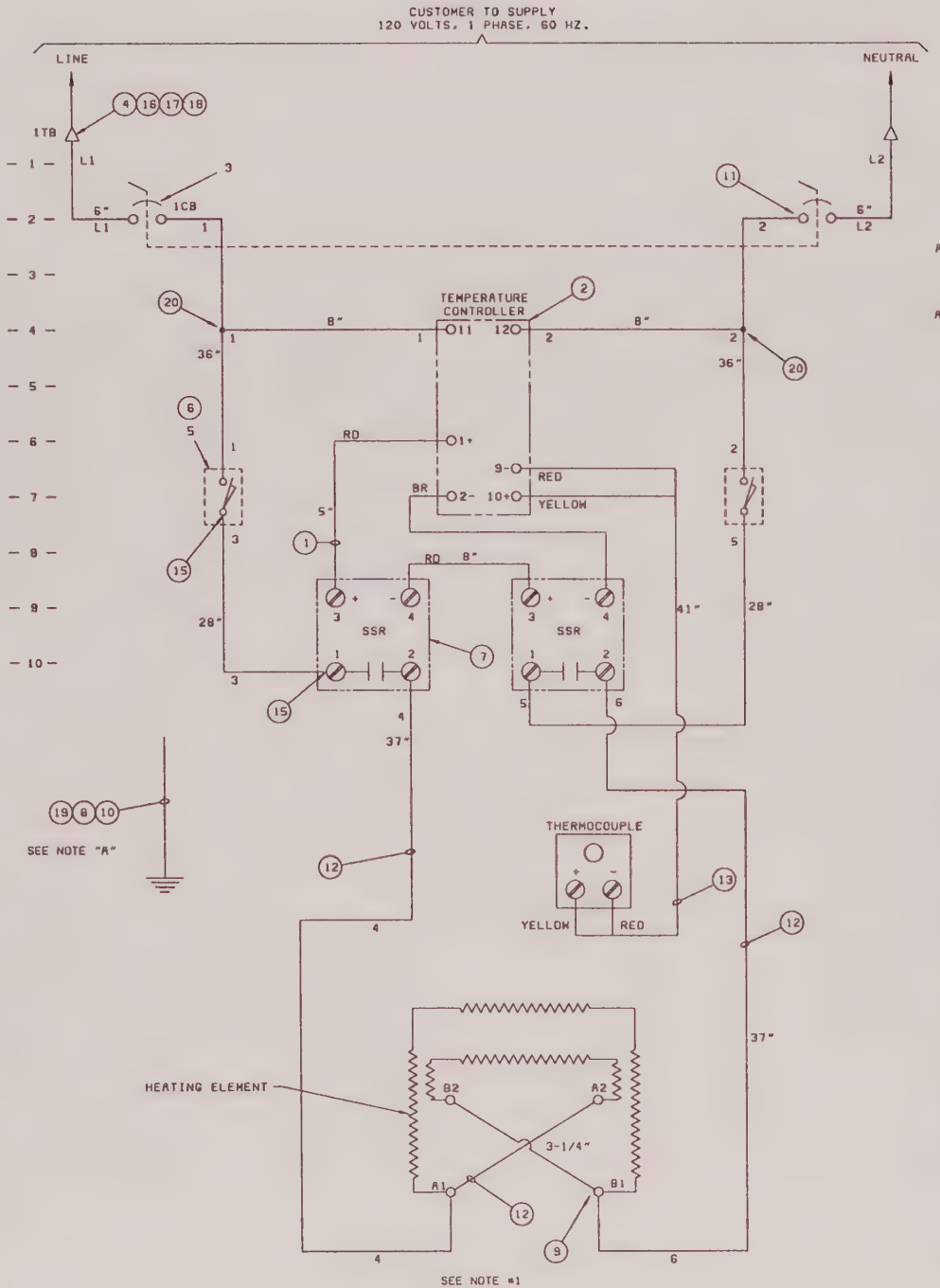
1800 WATTS, 120 VOLTS, 15 AMPS
1800 WATTS, 240 VOLTS, 7.5 AMPS

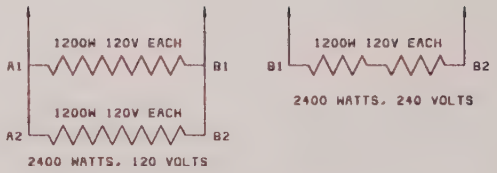


SCHEMATIC DIAGRAM OF HEATING ELEMENTS

ASSY QTY	PART NO.	ITEM	DESCRIPTION
-	102463	28	CONT,TEMP #847/LOGIC/422
-	104209	27	CONT,TEMP #847-MODULE/RS232
1	22010-023	26	WIRE 20GA TEW DARK BLUE X 1-1/2"
1	22010-033	25	WIRE 14GA TEW GREEN X 110"LG
		24	
		23	
		22	
1	2-7218-2052-0AS	21	CORD SET 15A 120V 6FT
2	22053-050	20	LUG,SLIP-ON 18-14GA PIGBK NONINS
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,ROHD SL 10-32 X 1-1/4
8	22063-026	15	LUG,SPADE 16-14GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 40"
1	22012-003	12	WIRE 14GA SEW-2 BLK X 224-1/2"LG
6	22060-005	11	LUG,SLIP-ON 16-14GA FEM NONINS
-	7214-8623-00A	10	CABLE,ASSY,W/JACK RS422 36"LG
7	22060-075	9	LUG,RING 16-14GA #STUD
-	7214-8622-00A	8	CABLE ASSY,W/JACK RS232C 30"LG
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32600-013	3	CB 20A 2P 240V
1	10147	2	CONT,TEMP #847P
1	22006-001	1	WIRE 22GA BROWN/RED X 13"LG

51766



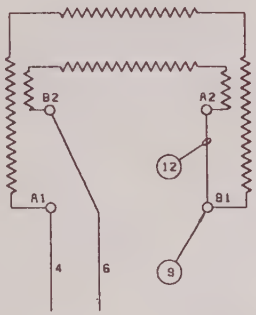


SCHEMATIC DIAGRAM OF HEATING ELEMENTS

NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

MODEL #51766 BOX FURNACE

2400 WATTS, 120 VOLTS, 20 AMPS
2400 WATTS, 240 VOLTS, 10 AMPS



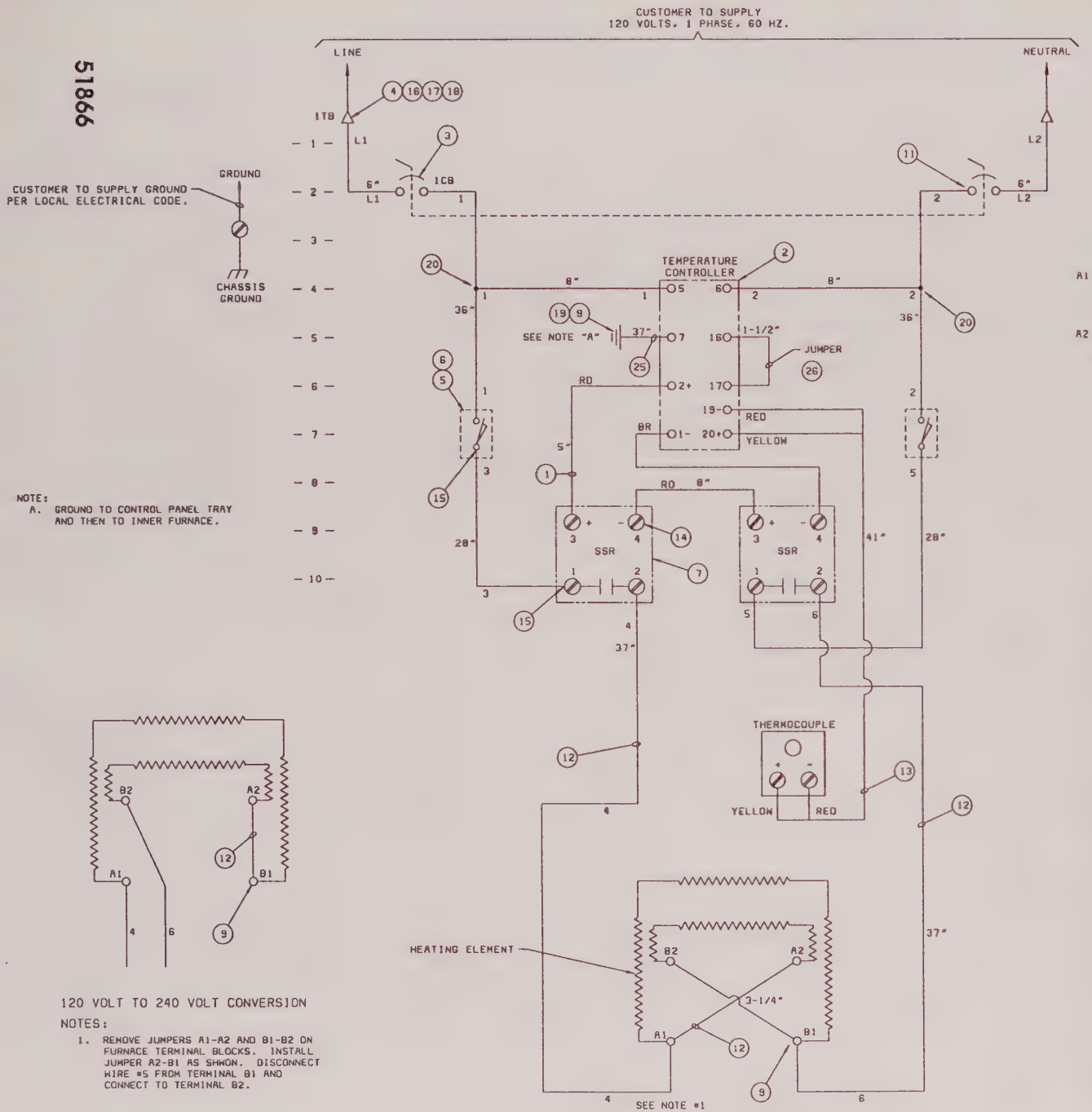
120 VOLT TO 240 VOLT CONVERSION

NOTES:

1. REMOVE JUMPERS A1-A2 AND B1-B2 ON FURNACE TERMINAL BLOCKS. INSTALL JUMPER A2-B1 AS SHOWN. DISCONNECT WIRE #5 FROM TERMINAL B1 AND CONNECT TO TERMINAL B2.

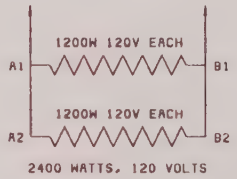
ASSY QTY	PART NO.	ITEM	DESCRIPTION
2	22077-001	20	ADAPTER,SNAP-IN .250X.032"TAB
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,RDHD SL 10-32 X 1-1/4
8	22057-010	15	LUG,SPADE 12-10GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 41"
1	22012-005	12	WIRE 12GA SEW-2 BLK X 236-1/2"LG
6	22060-050	11	LUG,SLIP-ON 12-10GA FEM NONINS
1	22010-033	10	WIRE 14GA TEW GREEN X 120"LG
8	22055-007	9	LUG,RING 12-10GA 10STUD
1	22060-075	8	LUG,RING 16-14GA 10STUD
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32602-001	3	CB 28A 2P 277V
1	4-7014-1085-001	2	CONT,TEMP #AT16
1	22006-001	1	WIRE 22GA BROWN/RED X 13"LG

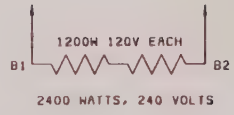
51866



MODEL #51866 BOX FURNACE

2400 WATTS, 120 VOLTS, 20 AMPS
2400 WATTS, 240 VOLTS, 10 AMPS





SCHEMATIC DIAGRAM OF HEATING ELEMENTS

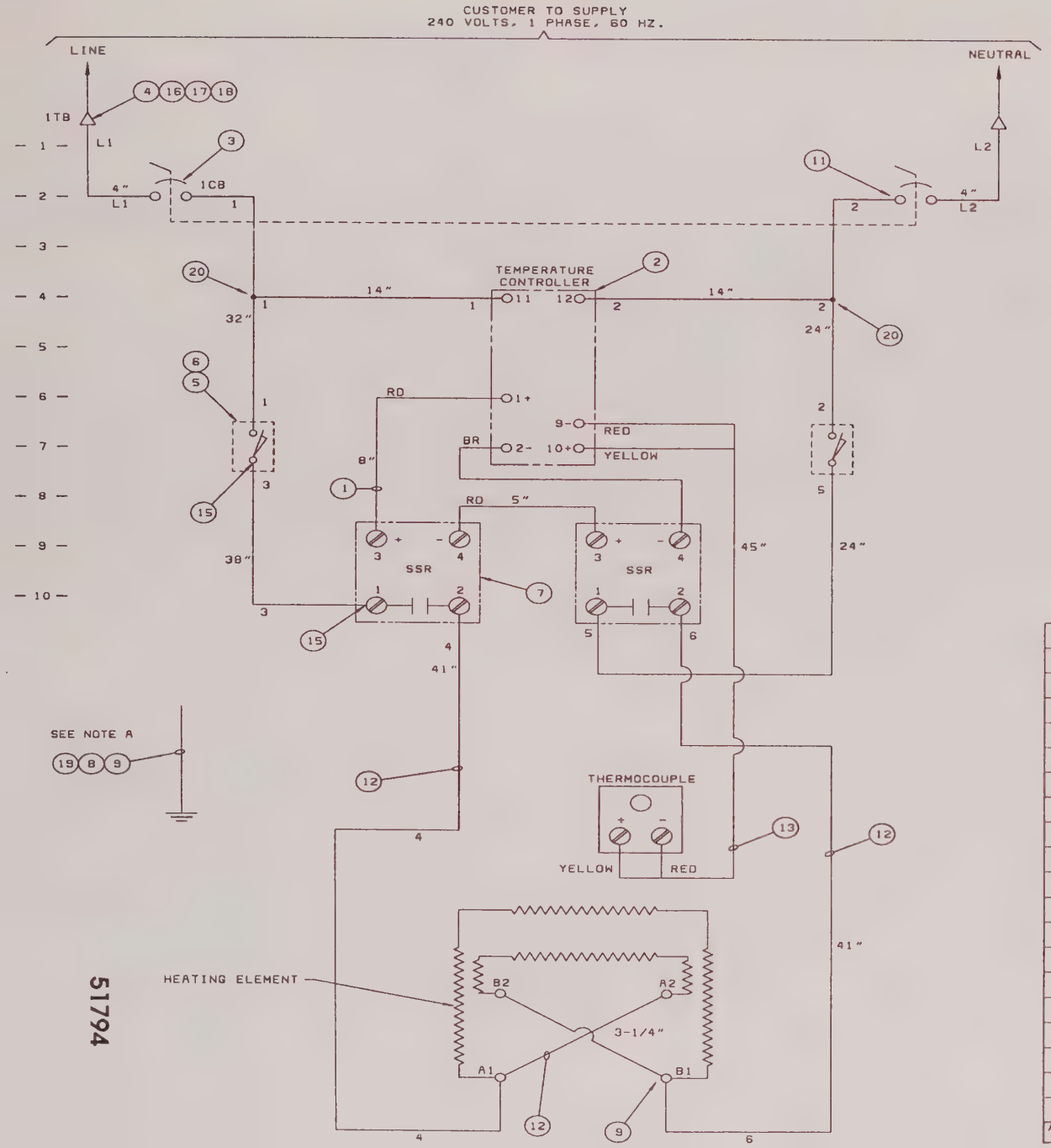
NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

120 VOLT TO 240 VOLT CONVERSION

NOTES:

1. REMOVE JUMPERS A1-A2 AND B1-B2 ON FURNACE TERMINAL BLOCKS. INSTALL JUMPER A2-B1 AS SHWON. DISCONNECT WIRE #5 FROM TERMINAL B1 AND CONNECT TO TERMINAL B2.

ASSY QTY	PART NO.	ITEM	DESCRIPTION
1	22010-023	26	WIRE 20GA TEW DARK BLUE X 1-1/2"
1	22010-033	25	WIRE 14GA TEW GREEN X 37"LG
		24	
		23	
		22	
		21	
2	22077-001	20	ADAPTER,SNAP-IN .250X.032"TAB
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,ROHD SL 10-32 X 1-1/4
8	22057-010	15	LUG,SPADE 12-10GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 41"
1	22012-005	12	WIRE 12GA SEW-2 BLK X 236-1/2"LG
6	22060-050	11	LUG,SLIP-ON 12-10GA FEM NONINS
		10	
9	22055-007	9	LUG,RING 12-10GA 10STUD
		8	
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32602-001	3	CB 20A 2P 277V
1	10147	2	CONT,TEMP #847P
1	22006-001	1	WIRE 22GA BROWN/RED X 13"LG



51794

NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

3500 WATTS, 240 VOLTS

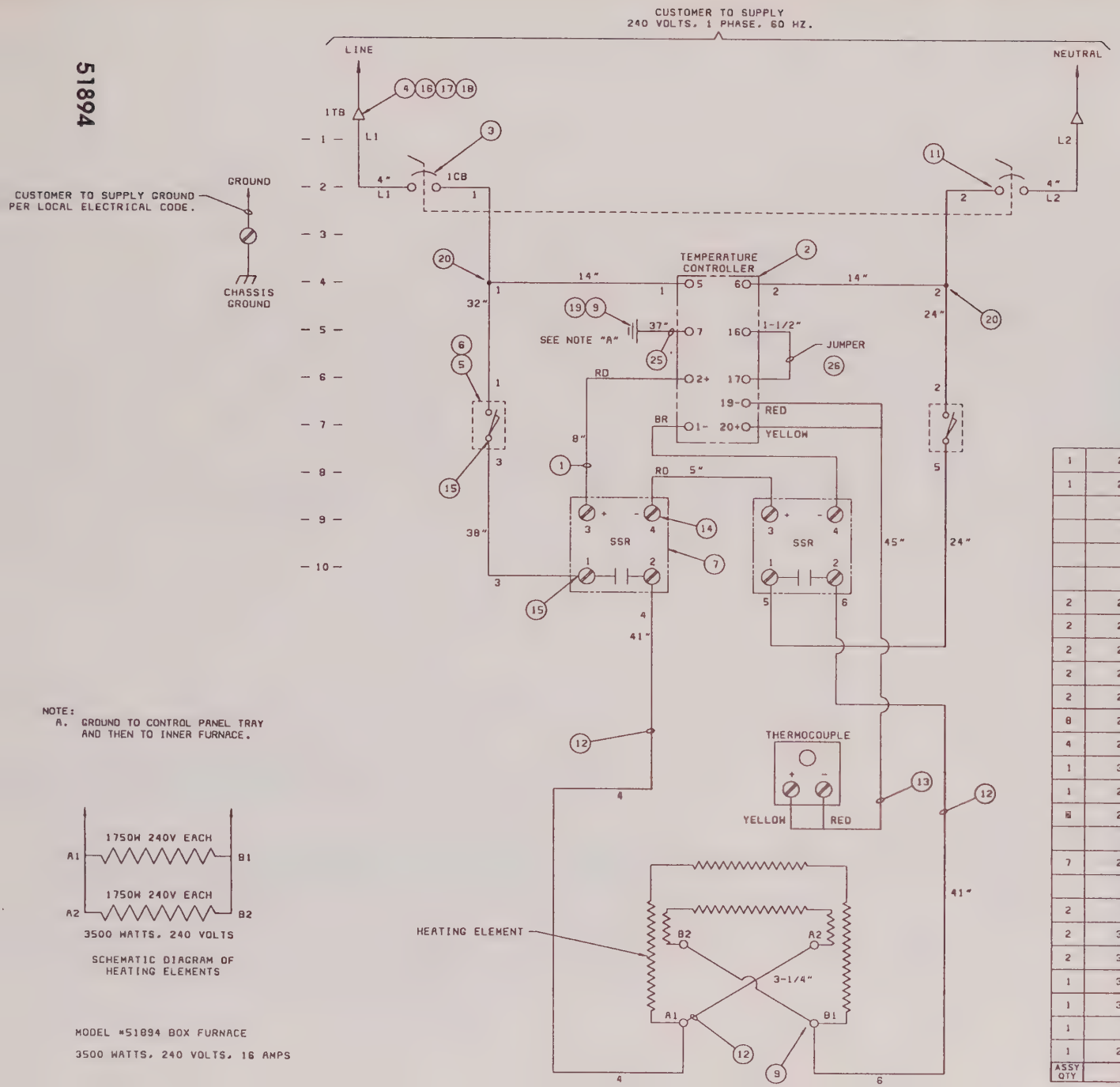
SCHEMATIC DIAGRAM OF HEATING ELEMENTS

MODEL #51794 BOX FURNACE

3500 WATTS, 240 VOLTS, 16 AMPS

ASSY QTY	PART NO.	ITEM	DESCRIPTION
2	22053-050	20	LUG,SLIP-ON 18-14GA PIGBK NONINS
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,RDHD SL 10-32 X 1-1/4
8	22063-026	15	LUG,SPADE 16-14GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 45"
1	22012-003	12	WIRE 14GA SEW-2 BLACK X 243"LG
6	22060-005	11	LUG,SLIP-ON 16-14GA FEM NONINS
		10	
7	22060-075	9	LUG,RING 16-14GA #10STUD
1	22010-033	8	WIRE 14GA TEW GREEN X 120"LG
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32600-013	3	CB 20A 2P 240V
1	4-7014-1085-001	2	CONT,TEMP AT16
1	22006-001	1	WIRE 22GA BROWN/RED X 13"LG

51894



NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

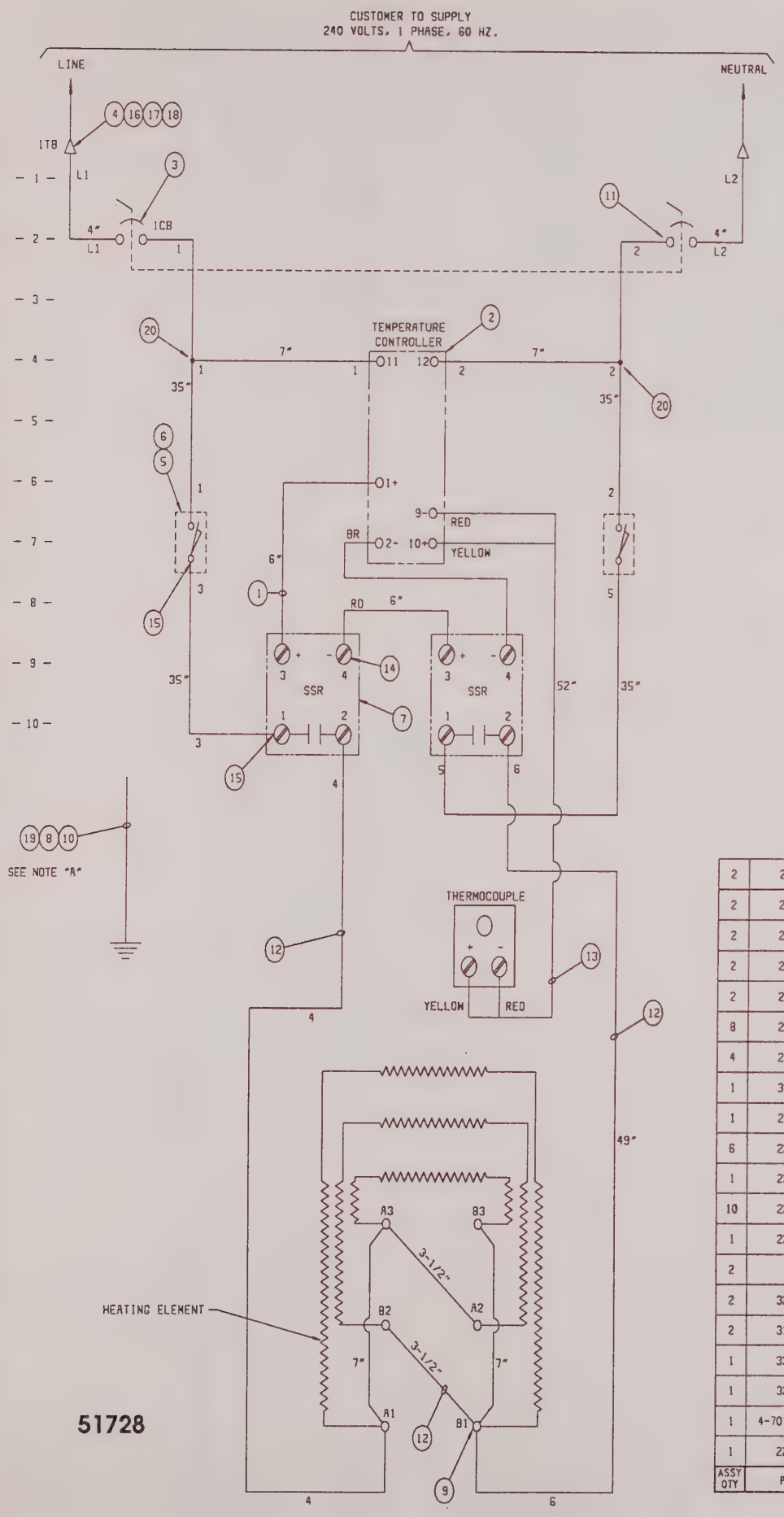
3500 WATTS, 240 VOLTS

SCHEMATIC DIAGRAM OF HEATING ELEMENTS

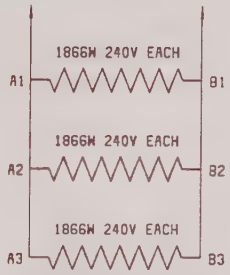
MODEL #51894 BOX FURNACE

3500 WATTS, 240 VOLTS, 16 AMPS

ASSY QTY	PART NO.	ITEM	DESCRIPTION
1	22010-023	26	WIRE 20GA TEW DARK BLUE X 1-1/2"
1	22010-033	25	WIRE 14GA TEW GREEN X 120"LG
		24	
		23	
		22	
		21	
2	22053-050	20	LUG,SLIP-ON 18-14GA PIGBK NONINS
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,RDHD SL 10-32 X 1-1/4
8	22063-026	15	LUG,SPADE 16-14GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 45"
1	22012-003	12	WIRE 14GA SEW-2 BLACK X 243"LG
1	22060-005	11	LUG,SLIP-ON 16-14GA FEM NONINS
		10	
7	22060-075	9	LUG,RING 16-14GA 10STUD
		8	
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32600-013	3	CB 20A 2P 240V
1	10147	2	CONT,TEMP #847P
1	22006-001	1	WIRE 22GA BROWN/RED X 13"LG



NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.



5598 WATTS, 240 VOLTS

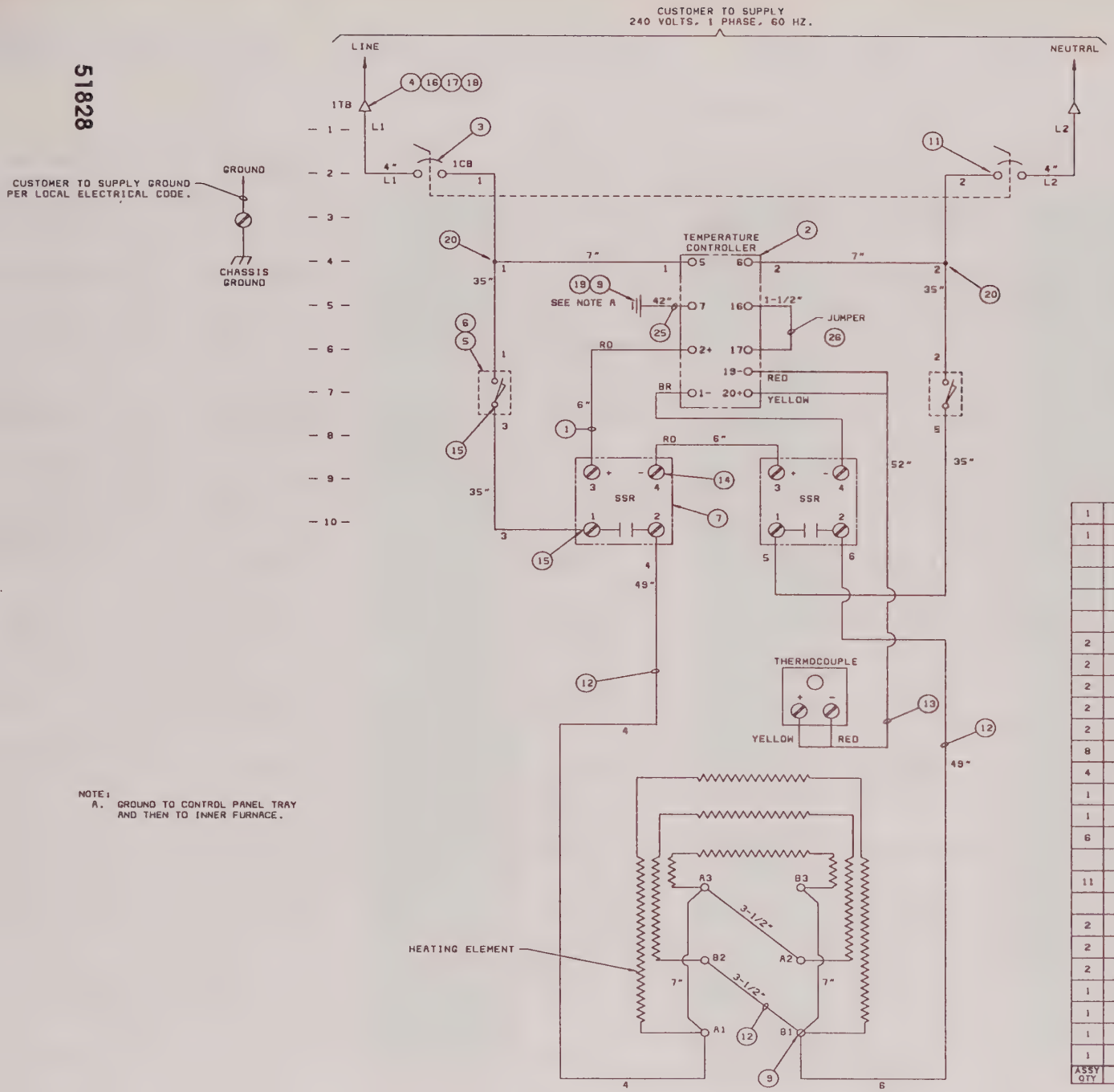
SCHEMATIC DIAGRAM OF HEATING ELEMENTS

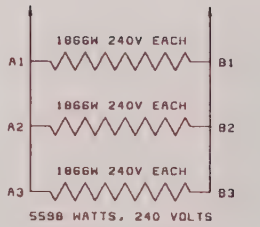
MODEL #51728 BOX FURNACE

5598 WATTS, 240 VOLTS, 23.3 AMPS

ASSY QTY	PART NO.	ITEM	DESCRIPTION
2	22077-001	20	ADAPTER,SNAP-IN .250X.032"TAB
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,ROHO SL 10-32 X 1-1/4
8	22057-010	15	LUG,SPADE 12-10GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 52"
1	22012-011	12	WIRE 10GA SEW-2 BLACK X 281"LG
6	22060-050	11	LUG,SLIP-ON 12-10GA FEM NONINS
1	22010-033	10	WIRE 14GA TEW GREEN X 130"
10	22055-007	9	LUG,RING 12-10GA #STUD
1	22060-075	8	LUG,RING 16-14GA #STUD
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32602-001	3	CB 28A 2P 277V
1	4-7014-1085-001	2	CONT,TEMP #AT16
1	22006-001	1	WIRE 22GA BROWN/RED X 12" LG

51828





SCHEMATIC DIAGRAM OF HEATING ELEMENTS

MODEL #51828 BOX FURNACE

5598 WATTS, 240 VOLTS, 23.3 AMPS

NOTE:
A. GROUND TO CONTROL PANEL TRAY AND THEN TO INNER FURNACE.

ASSY QTY	PART NO.	ITEM	DESCRIPTION
1	22010-023	26	WIRE 20GA TEW DARK BLUE X 1-1/2"
1	22010-033	25	WIRE 14GA TEW GREEN X 130"LG
		24	
		23	
		22	
		21	
2	22077-001	20	ADAPTER,SNAP-IN .250X.032"TAB
2	22078-002	19	SCRULUG,1/4" STUD
2	20084-003	18	WASHER,LOCK #10
2	20102-013	17	NUT,HEX MACH 10-32
2	20016-083	16	SCREW,ROHD SL 10-32 X 1-1/4
8	22057-010	15	LUG,SPADE 12-10GA #STUD INS
4	22064-018	14	LUG,SPADE 22-16GA #STUD INS
1	33940-002	13	LEADWIRE,TC 20GA K DUP X 52"
1	22012-011	12	WIRE 10GA SEW-2 BLACK X 281"LG
6	22060-050	11	LUG,SLIP-ON 12-10GA FEM NONINS
		10	
11	22055-007	9	LUG,RING 12-10GA 10STUD
		8	
2	102460	7	RELAY,SS 45A 240AC
2	32567-002	6	BRACKET,MTG MICROSWITCH
2	31604-016	5	SWITCH,LIMIT 25A 480V
1	33407-002	4	BLOCK,TERM 4P 55A 600V
1	32602-001	3	CB 20A 2P 277V
1	10147	2	CONT,TEMP #847P
1	22006-001	1	WIRE 22GA BROWN/RED X 12" LG

PARTS SPECIFICATIONS

	MODEL #							
Part Description	**51748**	**51848**	**51766**	**51866**	**51794**	**51894**	**51728**	**51828**
Heating Unit	7011-2526-00A	7011-2526-00A	7011-2544-00A	7011-2544-00A	7011-2516-00A	7011-2516-00A	7011-2534-00A	7011-2534-00A
Thermocouple	7299-1186-00E	7299-1186-00E	7299-1186-00E	7299-1186-00E	7299-1186-00A	7299-1186-00A	7299-1186-00A	7299-1186-00A
Hearth Plate	7011-2022-00B	7011-2022-00B	7011-2022-00C	7011-2022-00C	7011-2051-00A	7011-2051-00A	7011-2066-00A	7011-2066-00A
Door Assembly	7011-2523-00A	7011-2523-00A	7011-2541-00A	7011-2541-00A	7011-2513-00A	7011-2513-00A	7011-2533-00A	7011-2533-00A
Temperature Controller	7014-1085-001	10147	7014-1085-001	10147	7014-1085-001	10147	7014-1085-001	10147
Solid State Relay	102460	102460	102460	102460	102460	102460	102460	102460
Circuit Breaker	32600-013	32600-013	32602-001	32602-001	32600-013	32600-013	32602-001	32602-001
Terminal block	33407-002	33407-002	33407-002	33407-002	33407-002	33407-002	33407-002	33407-002
Thermocouple Wire	33940-002	33940-002	33940-002	33940-002	33940-002	33940-002	33940-002	33940-002
Door Insulation	7011-2523-00B	7011-2523-00B	7011-2541-00B	7011-2541-00B	7011-2513-00B	7011-2513-00B	7011-2533-00B	7011-2533-00B
Door Cutout Switch	31604-016	31604-016	31604-016	31604-016	31604-016	31604-016	31604-016	31604-016
Door Handle	16041	16041	16041	16041	16041	16041	16041	16041
Magnet	16405	16405	16405	16405	16042	16042	16042	16042

Manufacturer: Lindberg, A Unit of General Signal
Address: 304 Hart Street
Watertown, WI 53094
Telephone: (414) 261-7000

Revision Date: November 6, 1992 Replaces MSDS dated: August 14, 1987

Completed by: Lindberg Unit Environmental, Safety, and Health Department

I. PRODUCT IDENTIFICATION

Trade Name: Moldatherm II ® Insulation (Also known as Moldatherm ® Insulation)

Synonyms: Refractory Ceramic Fibers (RCFs); Ceramic Fiber; Man-Made Vitreous Fibers (MMVF); Mullite; High Alumina Ceramic Fiber

Chemical Family: Vitreous Aluminosilicate Fibers

Molecular Formula: $Al_2O_3 \bullet SiO_2$

II. PRODUCT COMPOSITION

Component	CAS No.	Percent (%)	Exposure Limits (8 hr. TWA)
Aluminosilicate	NA—Mixture	79 to 99	1.0 fibers/cc**
Silica, amorphous	7631-86-9	1 to 21	10 mg/m³ ACGIH/TLV 6 mg/m³ OSHA/PEL

Remaining components not determined hazardous and/or other components present at less than 1.0% (0.1% for carcinogens).

**NOTE: No OSHA or ACGIH exposure limits have been established for this material. The user is advised to follow the Lindberg Recommended Exposure Limit (REL). (See Section VII. Personal Protective Equipment)

Moldatherm® insulation will partially convert to cristobalite (CAS No. 14464-46-1), a form of crystalline silica, at operating temperatures at or above 1800 °F. The rate and percentage of conversion to cristobalite is time and temperature dependent. (See Section X. Special Precautions/ Supplemental Information.) Cristobalite has an OSHA permissible exposure limit (PEL) and ACGIH threshold limit value (TLV) of 0.05 mg/m³ (respirable dust).

III. PHYSICAL DATA

Boiling Point:	NA	Vapor Pressure:	NA	Vapor Density:	NA
Evaporation Rate:	NA	% Volatile	NA	Water Solubility (%):	Nil
Melting Point:	Greater than 3000°F	Odor/Physical Description:		White, odorless solid	

NA = Not Applicable

Pleural plaques (thickening along the chest wall) have been observed in a small number of employees who had a long duration of employment. There are several occupational and non-occupational causes for pleural plaque. Plaques are not "pre-cancer" nor are they associated with any measurable effect on lung function.

H. Toxicology:

Several health effect studies of inhalation exposure of rats and hamsters are now reaching completion. In a lifetime nose-only inhalation study, rats exposed to a very high dose of 30 mg/m³ (200 fibers/cc) developed progressive lung damage (interstitial fibrosis) and cancers of the lung and of the pleura (lining of the chest wall and lung). In contrast, hamsters similarly exposed developed interstitial fibrosis and pleural cancer, but no lung cancer. Cancer of the pleura is called mesothelioma.

A multiple dose study (3, 9, 16 mg/m³ or 25, 75, 150 fibers/cc, respectively) is currently ongoing in rats. After 24 months of exposure, only reversible cellular changes have been seen in the low dose group. At 9 mg/m³ (75 fibers/cc), areas of lung fibrosis are barely discernible and at 16 mg/m³ (150 fibers/cc) both lung and pleural fibrosis are present.

At this time, no lung or pleural cancer has been seen in the multiple dose study. This information will be updated once the study is completed.

In 1987, the International Agency for Research on Cancer (IARC) reviewed the carcinogenicity data on man-made vitreous fibers (including ceramic fiber, glasswool, rockwool, and slagwool). IARC classified ceramic fiber, fibrous glasswool and mineral wool (rockwool and slagwool) as possible human carcinogens (Group 2B).

VI. EMERGENCY AND FIRST AID PROCEDURES

Ingestion:	Drink extra water. Allow for natural gastrointestinal elimination. Get medical attention if gastrointestinal symptoms develop (see Section V.).
Skin Contact:	Remove contaminated clothing. Wash affected skin thoroughly with soap and water. Do not rub or scratch exposed skin. A skin cream or lotion used after washing may be helpful. Seek medical attention if irritation persists.
Eye Contact:	Immediately rinse eyes with water. Remove any contact lenses, and continue flushing eyes with running water for at least 15 minutes. Do not rub eyes. Hold eyelids apart to ensure rinsing of the entire surface of the eyes and lids with water. Get immediate medical attention.
Inhalation:	Remove exposed person to fresh air. Seek medical attention if shortness of breath, cough, wheezing or chest pain develop. If breathing is labored, administer oxygen until medical assistance can be rendered.

VII. PERSONAL PROTECTIVE EQUIPMENT

Eyes:	Wear safety glasses or chemical goggles. Contact lenses should not be worn unless chemical goggles are also used and care is taken to not touch the eyes with contaminated body parts or materials.
Skin:	Wear gloves, hats and full body covering to prevent skin irritation as necessary (see Section X.).

Waste Disposal:

This waste is not specifically listed as a hazardous waste under Federal regulations. However, it could be characteristically hazardous if it is considered toxic, corrosive, ignitable, or reactive according to Federal definitions (40 CFR 261). Additionally, it could be designated as hazardous or a special waste according to state regulations. This substance could also become a hazardous waste if it is mixed with or otherwise comes in contact with hazardous waste. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this MSDS incomplete, inaccurate or otherwise inappropriate.

The transportation, storage, treatment, and disposal of this waste material must be conducted in compliance with all applicable Federal, state, and local environmental regulations.

SARA Title III Information:

This material is designated a "delayed hazard" per the Superfund Amendments and Reauthorization Act (SARA) Section 311/312 (40 CFR 370).

This product does not contain any toxic chemicals subject to the reporting requirements of SARA Section 313 (40 CFR 372).

This product contains ceramic fibers which are on the State of California "Proposition 65" list (Safe Drinking Water and Toxic Enforcement Act of 1986).

The Canadian Workplace Hazardous Materials Information System (WHMIS) category of "Other Toxic Effects" applies to this product.

This product is not a DOT listed hazardous material. Use product name for bill of lading description.

Some states have "special waste" regulations or other regulations which may apply to this product. Consult with your state environmental regulatory authorities.

X. SPECIAL PRECAUTIONS/SUPPLEMENTAL INFORMATION

Handling/Storage:

Moldatherm® insulation should be handled with caution. Follow the personal protective equipment recommendations detailed in Section VII. Special precaution should be taken to avoid unnecessary cutting and tearing of the material to minimize generation of airborne dust.

Clothing:

Full body clothing is recommended to reduce the possibility of skin irritation. If possible, do not take unwashed work clothes home. Work clothes should be washed separately from other clothing. Rinse the washing machine thoroughly after laundering the work clothes. Inform your launderer of this cleaning procedure.

NA = Not Applicable

⚠ WARNING

This product contains refractory ceramic fiber and/or firebrick (cilica) insulation and, after services at temperatures greater than 1800° F. may form and therefore may contain cristobalite (crystalline silica). The following hazards pertain to exposure to insulation dusts:

DUST CAN CAUSE SEVERE RESPIRATORY DISEASE (SILICOSIS).
DUST MAY BE IRRATATING TO SKIN, EYES, ANDRSPIRATORY TRACT.
SUSPECT CANCER HAZARD BY INHALATION.

Refractory Ceramic Fibers MAY CAUSE CANCER BASED ON ANIMAL DATA
and Cristobalite (Crystalline Silica) MAY CAUSE CANCER.

Risk of cancer depends on duration and level of exposure.

BEFORE USING OR MAINTAINING THIS EQUIPMENT, READ THE MATERIAL SAFETY DATA SHEET (MSDS) ON THIS INSUALTION.

WHEN INSTALLING, MAINTAINING, OR REMOVING THIS REFRACTPORY INSULKATION, TAKE THE FOLLOWING PRECAUTIONS TO MINIMIZE EXPOSURE TO THE DUST AND/OR CERAMIC FIBERS.

Avoid breathing dust. Keep personnel exposure to airborne dust and particles from the insulation as low as possible. Use engineering controls where feasible.

Avoid unnecessary cutting and tearing of the materiality minimize generation of airborne dust.

Insulation surfaces should be lightly sprayed with water or other suitable wetting agents before removal to suppress dust. Spray additional water or wetting agents to replace liquids which evaporate during removal. A surfactant may aid the wetting process.

Dust suppressing cleaning methods, such as wet sweeping or vacuuming should be used to clean the work area. If dry vacuuming is used the vacuum must be equipped with a HEPA filter. Air blowing or dry sweeping should not be used. Do NOT use compressed air. Dust suppressing compounds may be used to clean up light dust.

As minimum protection, use a high efficiency air purifying half-face respirator equipped with HEPA filter cartridges if airborne fiber levels or cristobaliteconcentrations are not known.

Avoid contact with eyes, skin, and clothing. Wear long sleeve clothing, gloves, hat, and eye protection to minimize skin and eye contact. Contact lenses should not be worn when handling.

Wash thoroughly immediately after completing work.

Launder work clothing separately from other clothes and thoroughly clean laundering equipment after use. clothing which contains a large amount of dust and/or refractory ceramic fiber should be disposed.

Promptly place used refractory ceramic fiber parts and dusts in plastic bags or other suitable containers and dispose according to local, state, and federal waste disposal (environmental) regulations.

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